

Green Cleaning

of Gauges

Using an Environmentally Friendly Solvent to Clean Non-Oxygen System Gauges

Engineers from the Portsmouth Naval Shipyard (PNS) found a green, environmentally friendly solution for cleaning non-oxygen system gauges. And the new chemical is not an Ozone Depleting Substance (ODS).

The Navy uses gauges to measure many things such as temperature, pressure and flow. Some of the gauges are reading an electrical signal (like thermocouples), but most gauges must physically touch the fluid to obtain a reading. Water and particles can contaminate the fluid during normal use. This contamination can affect the accuracy of the readings. When this happens the gauges must be either replaced or cleaned. Gauges can be divided into two basic types: gauges for oxygen system service and gauges for other purposes.

Oxygen system gauge cleaning requires stringent controls to ensure that no residue that could cause a fire upon contact with oxygen remains after the cleaning is complete. The Navy uses Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane; Chemical Abstract Service No. 76-13-1) for oxygen system gauge cleaning. It is the Navy's only authorized use for Freon 113 (according to OPNAV Instruction 5090.1B Change 2, Chapter 6 paragraph 5.7.1(d)).

Cleaning of non-oxygen system gauges has not been so clearly specified. A common method to clean these types of gauges involves a piece of equipment specifically designed to clean gauges with a liquid solvent and then remove the residual solvent using a vacuum pump. An example of this type of equipment is the King Nutronics Model 3646.

The solvent is pumped into the gauge and circulated. The residual liquid is then removed using a vacuum pump. The vacuum removal process lowers the pressure inside the gauge enough to make the solvent liquid vaporize and be removed as a gas. The machine then collects the spent liquid solvent in a container. King Nutronics recommends using the Genesolv 2000 solvent (manufactured by Astro Chemicals Company) or an equivalent. Genesolv 2000 is 100 percent Dichlorofluoroethane (also known as HCFC141b Chemical Abstract Service No. 1717-00-6) and therefore a class II ODS.

PNS personnel clean gauges used in lubricating and hydraulic service on submarines. PNS concluded that Genesolv 2000 was not environmentally friendly and began the search for a replacement. PNS specified the following requirements during its search for a suitable substitute for Genesolv (in order of preference):

1. The solvent must work in the existing gauge cleaning machine. (Liquids that are in the gauge must be vaporized for removal.)

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The King Nutronics Model 3646 Gauge Cleaner.
Photos courtesy of King Nutronics



2. The solvent must not be flammable or combustible.
3. The solvent must not be a class I or II ODS.
4. The solvent must not generate a hazardous waste when spent.

King Nutronics suggested using a new product that they approved called HFE-7100 manufactured by the 3M Corporation. PNS consulted with 3M on the specified use of this product. PNS cleans mostly lubricating and hydraulic system gauges. Tom Brodbeck, 3M's government account manager, suggested the HFE-71DE solvent as a suitable substitute. HFE-71DE is an azeotropic blend of solvents (including HFE-7100) designed for removing more tenacious oils like

lubricating oil. So 3M sent a sample of HFE-71DE to PNS for testing.

The PNS foreman and tool mechanics then set up the unit exactly the same as they would for using Freon 113. They obtained a spare dirty gauge and used the King Nutronics procedures to clean it. The first cleaning of the gauge using HFE 71DE had a very dirty effluent, as expected. The second cleaning resulted in a much cleaner effluent. The third and final cleaning resulted in a clear liquid indicating that cleaning was complete.

Mark Lucey, the tool room foreman, reported that the HFE-71DE "worked as well as Freon 113". The Material Safety Data Sheet and product literature for HFE-71DE indicated that it meets all four of the basic requirements for use at PNS.

PNS was concerned about worker exposure during the use of HFE-71DE. Tom Brodbeck provided volumes of literature and even air monitoring samplers to assist in evaluating the impact on the workers. PNS conducted air monitoring and found that there was no significant exposure to the employees.

HFE-71DE is available in the National Stock System with the stock number of 6850-01-459-0069. More information about King Nutronics gauge cleaners can be found at <http://www.kingnutronics.com/m3646.htm>. Additional information on the HFE-71DE solvent can be found at the 3M website: <http://www.3m.com>. [⚓](#)

CONTACTS

Mark Hume
Portsmouth Naval Shipyard
207-438-4531
DSN: 684-4531
humemarkg@mail.ports.navy.mil

Tim Dunn
Portsmouth Naval Shipyard
207-438-3831
DSN: 684-3831
dunntp@mail.ports.navy.mil